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ſo many forrein *Virtuoſi* of great fame and ſolid worth, to afford conſiderable Aſſiſtance towards the Propagation of Philoſophical Arts, and the Advancement of knowledg. Of which many pregnant Inſtances and manifeſt Matters of Fact do bear evidence, as they are with faithfulneſs, but without artifice or elaboratneſs, regiſtred in theſe un-poliſh't Volumes.

A Diſcovery of two New Planets *about* Saturn, *made in the Royal Pariſian Obſervatory by Signor* Caſſini, *Fellow of both the Royal Societys, of* England *and* France; *Engliſh't out of French.*

I.

A Diſcovery of 10 *ſmall Fixt Stars, and of one New Planet, firſt.*

ABout the end of *October* 1671. Saturn paſs'd cloſe by *Four* ſmall Fix't Stars, viſible only by a Teleſcope, within the *ſinus* of the Water of *Aquarius*, which *Rheita* once took for New Satellits of Jupiter, calling them *Urban-octavians*; but which *Hevelius* (who called them *Vladiſlavians*) ſhew'd to be ſome of the common Fix't Stars, that may every day be ſeen by a Teleſcope any where in the Heavens.

This Paſſage of Saturn gave us occaſion to diſcover in the ſame place, within the ſpace of 10 minuts, by a Teleſcope of 17 feet, made by *Campani*, *Eleven* other ſmaller Stars, one of which, by its particular motion, ſhew'd it ſelf to be a true *Planet*: which we found by comparing it not only to Saturn and his Ordinary Satellit, diſcovered 1655 by Mr. *Hugens*, but alſo to other Fix't Stars, and particularly to three, marked *a*, *b*, *d*, in the Firſt *Table*, where, to avoid a long explication of our firſt Obſervations, we have deſcribed the way of Saturn, and that of the New Planet, alwayes *marked* c, beginning from *October* 25. unto *Novemb.* 6. We have added to it the Ordinary Satellit, without any particular mark, becauſe he is eaſie to be known, being in theſe obſervations always next to Saturn. The diſtances are repreſented in their juſt proportions; but to make Saturn more remarkable in the Table, he is repreſented twice bigger than he ſhould be in proportion to the diſtances *.

See Tab. I. *Fig.* II.

* Note, *that in* Tab. I. fig. I. *the diviſions mark'd in the great-ſt Circle do denote the days of the* 3 *months, nominated within that circle.*

Theſe

Theſe Obſervations ſhew a motion of this New Planet that is very manifeſt in reſpect of the Fix't Stars, but leſs ſenſible in reſpect of Saturn. Yet it appears, that from *Octob.* 25. unto *Novemb.* 1. his diſtance from Saturn increaſed Weſtward, and from that time unto *Novemb.* 6. it diminiſhed; ſo that his greateſt digreſſion from Saturn hapned in the beginning of *Novemb.* and was found to be of 8 minuts, or of $10\frac{1}{2}$ diameters of Saturns Ring. Whence it was conſequent, *that*, if this Planet were a Satellit of Saturn, he muſt be unto the end of *September* in the inferior part of his Circle, and from the beginning of *November* in the ſuperior part; and *that* his revolution about Saturn was of a long duration, ſince for 12 days together he not only remain'd on the ſame Occidental ſide of Saturn, but there was alſo little change of apparent diſtance between him and Saturn. The greateſt digreſſion of this Planet was *treble* to that of the *ordinary* Satellit, and this enabled us to judge the Time of his revolution to be *quintuple*, applying to the Satellits that proportion, which *Kepler* hath noted in the Principal Planets, between the periodical Times and their Diſtances. But there was one circumſtance, which made us doubt, whether it were a *Satellit* or a *Principal Planet*, which was; That in the laſt obſervations we took notice, that he had a *little* Southern latitude in reſpect to the Line of the wings of Saturn, which we had not obſerved in the *firſt*, when he was neareſt to Saturn; which happens not to the other Satellit, which hath always the *more* latitude, the *nearer* he is to Saturn; yet it might well be, that the Circle of this Planet might have ſome declination from the Circle of the other Satellit, as it comes to paſs in the Principal planets, the Circles of which are inclined to one another. However this difficulty made us ſuſpend our Judgment until we could make ſuch a number of obſervations, as might ſuffice for a more preciſe determination.

II.

A pourſuit of the New Planet.

See Tab. I. Fig. II. BUT the Sky being over-caſt for many days, did interrupt our obſervations. However we ſaw Saturn *Novemb.* 12. 16. 17. 19. 23; and obſerved, that he was yet more approach'd to the Fixed ſtars, *b*, *d*, but we could find no foot-ſtep at all of the New Planet. And we had little hopes left us of finding him again by the ſame Teleſcope, by which he had appeared very ſmall towards the end. Notwithſtanding, whileſt we expected a greater Teleſcope, we were not wanting, during ſome intervals of fair weather, to ſeek, if we might not again meet with ſome ſuch Star about Saturn.

See Tab. II. Fig. I. We found then *Decemb.* 16. of the ſame year, that Saturn had retaken his round figure, and that on the Eaſt of him there was a ſmall ſtar, far diſtant, in a ſtraight line to Saturn, and to his ordinary Satellit, which was Oriental alſo, but little diſtant from Saturn. And *Decemb.* 24. we ſaw this Satellit in the Weſt, and a Star, Oriental likewiſe, leſs diſtant from Saturn than that we had ſeen the *16th.* But the weather did not permit us to verifie, whether it was the ſame. At length, *Januar.* 18. 23, 25, of the year 1672. we ſaw on the Weſt of Saturn, ſometimes one ſtar, ſometimes many, far diſtant, almoſt in a direct line to his ordinary Satellit; which made us hope to ſee another time the New Planet towards his greateſt Weſtern digreſſion; but theſe Obſervations were the laſt, which the weather ſuffered us to make, before Saturn did abſcond himſelf in the beams of the Sun.

We repreſent in the ſecond *Table Fig.* I. ſome of theſe interrupted Obſervations, though they be but made by the eſtimate of the Eye, and we then were not able to make out what kind of Stars they were.

After my return from a voyage of *Provence*, having brought with me from *Marſeilles*, in the beginning of *Novemb.* 1672. an excellent Teleſcope of 35 foot, which *Campani* had made by order of his Majeſty; we ſet it up in the Royal Obſervatory, directing it to Saturn, as ſoon as the weather would give leave,

to

to ſeek for the New Planet. In the firſt obſervations, made *Decemb.* 13 and 17, we perceived an Occidental Star, remote from Saturn, which in both theſe obſervations had a Southern latitude in reſpect to the line of his wings; but in the firſt it was further diſtant from Saturn than in the ſecond: So that, if this was the ſame Star, as I *ſuppoſed* it to be, not having been able to *make it out*, by comparing it with Fixed ones, there being at that time none within the Aperture of the Teleſcope; it moved towards Saturn on the Eaſt, and conſequently (ſuppoſing it to be his Satellit) it was in the ſuperior part of his Circle. *See Tab. II. Fig. I.*

III.

A Diſcovery of another New Planet.

WE could not ſee Saturn again but the 23th of *December*, and then in the preſence of Meſſieurs *Hugens*, *Picard*, *Mariotte*, *Romer*, and others of the *R. Academy of the Sciences*, we found a ſmall Star weſtward of Saturn, *between* him and his Ordinary Satellit, which was on the Weſt alſo, almoſt at a double diſtance. And at that time we had no other reaſon to ſuppoſe it to be different from the former, but that it had no latitude at all in reſpect of the Line of Saturn's wings. *See Tab. II. Fig. II.*

The weather did not ſuffer us to ſee Saturn again till the 30th of *December*; and then we ſaw a little Star, on the Eaſt of him, without any latitude between him and his Ordinary Satellit, which had paſſed alſo to the Eaſt of him. This obſervation, compared with the precedent, kept us yet in ſuſpenſe, becauſe we know not, *whether* this, which ſeem'd to us the ſame with that of the foregoing obſervation, had paſſed from one ſide of Saturn to the other, by one only motion ſlower than that of the ordinary Satellit, and conſequently by a little arch of a greater Circle; *or* whether, during this interval of time, it had made one or more turns by a leſſer Circle; which was much more accomodable to the poſition, in which it had appeared *without* Latitude in both obſervations; as ordinarily it befalls the Satellits, when they are in their greateſt digreſſions.

But we being not to rely upon theſe two Obſervations alone,

we

we were very impatient for an opportunity of giving our ſelves more ſatisfaction about this *phænomenon*. The heavens were not favourable to us till the 10*th* of *Januar.* 1673; and then this little Star appear'd to have return'd almoſt to the ſame poſition in reſpect of Saturn, and his ordinary Satellit, where it had been *Decemb.* 23. That which made us wonder, was, to have found three times conſecutively this ſmall Star between Saturn and his Ordinary Satellit, always in a diſtance almoſt equal from one and the other. But our admiration ceaſed at the fourth Obſervation, made *Januar.* 15, in which the Ordinary Satellit was Oriental, and the New one Occidental, as it had been in the precedent, but a little nearer to Saturn. We had that evening time enough attentively to obſerve this Planet for a whole hour together, during which we perceived, it approached to Saturn on the Weſt, and conſequently was in the ſuperior part of his Circle: which did fully confirm us in the ſuppoſition we were inclin'd to, that it was an *Interior* Satellit. Thus the purſuit of another Satellit, which we knew to be further diſtant from Saturn, and to have a longer period, made us diſcover this, which is nearer to it, and whoſe period is ſhorter.

See Tab. II. *Fig.* II.

IV.

An Hypotheſis of the Motion of the Interior Satellit.

THen it was, that comparing the Obſervations together, we began to find the Rule of the Motion of the New Interior Satellit. For the two laſt ſhew'd us, that in 5 days he had made more than a whole revolution. The firſt obſervation compar'd with the third made us Judge, that in 18 days he had made a Number of revolutions, almoſt whole ones, which certainly were four; each of them was of $4\frac{1}{2}$ days: So that between the 10*th* and 15*th* it might be, that there had been one revolution of $4\frac{1}{2}$ days, or two revolutions of $2\frac{1}{4}$ days each.

But the combination of the firſt with the ſecond made us ſeclude the period of $2\frac{1}{4}$ days. We therefore judged by theſe obſervations; *That* this laſt Planet finiſhes his revolution about Saturn in $4\frac{1}{2}$ days; *that* the Semidiameter of this Circle is of three

three Semidiameters and a fourth of Saturn's Ring; and *that* he was towards his greateſt Occidental digreſſion the 23th of *December*, and *Januar.* 1. about 7 a clock in the evening.

Upon theſe grounds, after the fourth Obſervation, we made an *Ephemerid* of this Planet, as it is repreſented in *Tab.* II. *Fig.* III; where we added that of the old Satellit; that ſo by the Obſervations where both are to be nigh to Saturn, men might be able to diſtinguiſh them: And this *Ephemerid* hath ſerv'd us ſince, untill the Occultation of Saturn; without having found any other difference in the following Obſervations, but that, as for the neareſt Planet, the Return to the ſame place, after one revolution of 4½ days, is made one hour later; ſo that one circuit is finiſh't in 4 days and 13 hours. We have alſo learned by the following obſervations, that when the *Interior* Satellit is much diſtant from his great digreſſions, he hath ſome Southern latitude in reſpect to the Line of the wings in the Upper ſemicircle, and ſome Northern latitude in the Inferior; as hath alſo the Old Satellit, which hath more of it in proportion to the diameter of his Circle. *See Tab. II. Fig. III.*

The Obſervations of this Planet were made not only with the Teleſcope of *Campani*, but alſo with one of *Divini* of 36 foot; and with one of the ſame length of Monſ. *Borelli*, who is a Member of the *R. Academy* of the Sciences.

V.

A Return to the Obſervations of the New Exterior *Satellit of Saturn.*

OUR application to obſerve the Planet neareſt to Saturn, in the ſmall time we had at evenings, by reaſon of his proximity to the Sun-beams, had diverted us from the other more remote Planet. But *February* 6. we began to ſee him again, and the weather favour'd us well enough to obſerve him almoſt all the days following untill the 20th of *February*, except the 9th and 18th. *See Tab. II. Fig. I.*

He was conveniently ſeen by *Campani's* Teleſcope of 17 foot, by which the firſt diſcovery of it had been made; and by another of 20 foot, made by *Le-bas*, with which Mr. *Picard*

obſerved him alſo unceſſantly, and ſometimes in the Company of Mr. *Hugens* and Mr. *Mariotte*. The firſt obſervations of the diſtances were made by an Eſtimate of the Eye, comparing the *exterior* Satellit to Saturn and to the other Satellits. The laſt were made by the meaſure of the Time between the paſſage of the Planet, and that of the Center of Saturn.

This New Planet did more and more remove from Saturn till the 9th of *February*, when we meaſur'd the difference between his paſſage and that of the Center of Saturn to be 30″ of an hour, which give at leaſt 10 diameters of Saturn; but on the 20th, he was already too near the beams of the Sun, to meaſure his diſtance; which yet by eſtimat was judged greater than it had been the 19th. The diverſe ſcituations of this Planet, in reſpect of Saturn and of the Line of the wings, between *Febr.* 6. and 19, are repreſented on the lower part of *Tab.* II. *Fig.* I.

By the apparent ſwiftneſs of his Motion during the firſt days, 'tis eaſie to ſee, that this Planet had been ſeen in Conjunction with Saturn *Febr.* 3; and by his motion on the Weſt it appears, that he was in the inferior part of his Circle: And becauſe during this time of 17 days he removed more and more from Saturn, 'tis certain that he remained in the ſame quadrant of the inferior Occidental Circle above 17 days, and that his whole Revolution is *more* than 68 days.

He was theſe laſt days at a diſtance almoſt equal to that which he had about the end of *Octob.* 1671; ſo that in 480 days or thereabout he made a certain number of Intire revolutions, which can be no more than 7; ſince each of them is without queſtion of more than 68 days. If you ſhould count 7 of them, each would be $68\frac{1}{2}$ days; if you count 6, each would be 80 days; if you count but 5, each would be 96 days. But this laſt ſuppoſition can by no means be made to agree with the two Obſervations of *Decemb.* 1672, and the firſt doth not agree ſo well with them as the ſecond.

The proportion of the apparent diſtances in the obſervations of *February*, which are the beſt, would make us eſtimate each of his Revolutions between 80 and 96 days; but the proportion of the greateſt digreſſion of 1671, compared with that

that of the two other Satellits, together with their periods, agrees better with 80 days. Therefore in the *Ephemerid* which we give of one Revolution, we follow this, untill we get a more preciſe determination, which requires a greater number of Obſervations, that cannot be begun but towards the next ſummer Solſtice, by reaſon of the Oblique Aſcenſion of Saturn, and his Southern latitude, which will keep him long in the beams of the Sun.

An Extract of a Letter, Written by David von der Becke, *a German Philoſopher and Phyſitian at* Minden, *to Doctor* Langelott, *Chief Phyſitian to his Highneſs the Duke of* Holſtein *now Regent, concerning the Principles and Cauſes of the* Volatiliſation *of* Salt of Tartar *and other Fixed Salts: Printed at* Hamburg, 1672.

THis Learned Author, having exploded the Uſeleſs and Empty terms of *Faculties*, *Qualities*, *&c.* and recommended the Inveſtigation of Nature by *Experiments* guided by *Reaſon*; commends, for the practice of this latter, that excellent Naturaliſt and Phyſitian, Dr. *Joel Langelott*, in that Diſcourſe of his, touching the great Uſe of *Digeſtion*, *Fermentation*, and *Grinding* in Chimiſtry; of which a Breviate was given in *Numb.* 87. of theſe Tracts. Out of which Diſcourſe he chuſeth, before all, to elucidate that part, which treats of the *Volatiliſation* of *Salt of Tartar*, as a Subject, which he had likewiſe conſidered and inquired into.

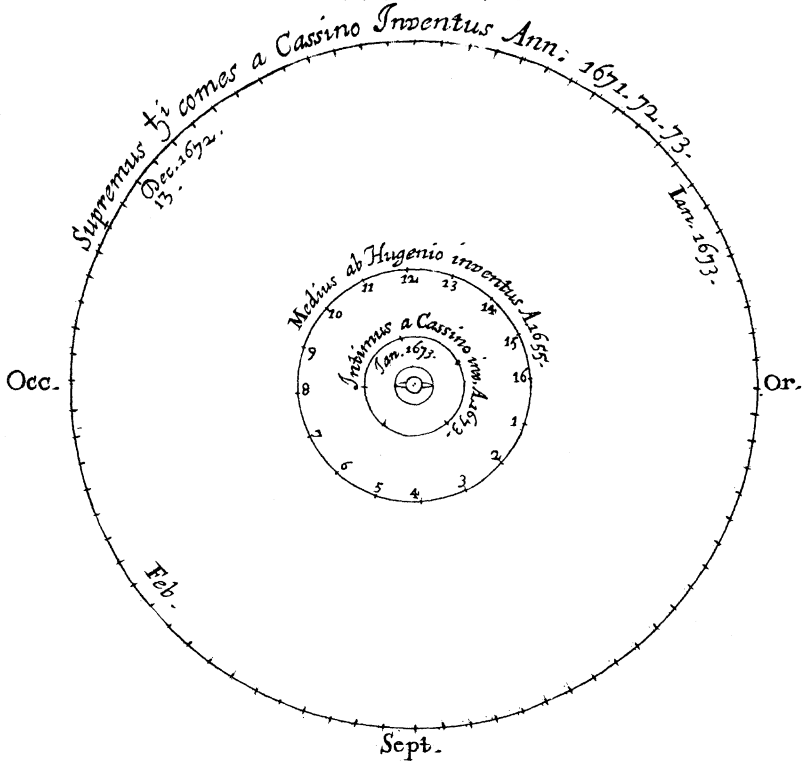
Having therefore (as he affirms, and as will appear by the ſequel,) formerly taken pains in the like Fermentation of Tartar for the *Volatilizing the Fixt Salt* thereof, he endeavours here to declare his thoughts about the *Cauſes* of his undertaking that labour, and of the *Manner* how that Volatiliſation is performed. In the doing of which he labours to ſhew, *firſt*, The *Cauſes* of the *Fixation* of the Salt of Tartar: *Secondly*, The *Reaſons* of the *Volatiliſation*: And *laſtly*, what *degree* of *Volatility* the Salt of Tartar hath acquired in that Fermentation made with its own Ferment.

As to the *firſt*, he begins with blaming thoſe, that divide

Tab. I.

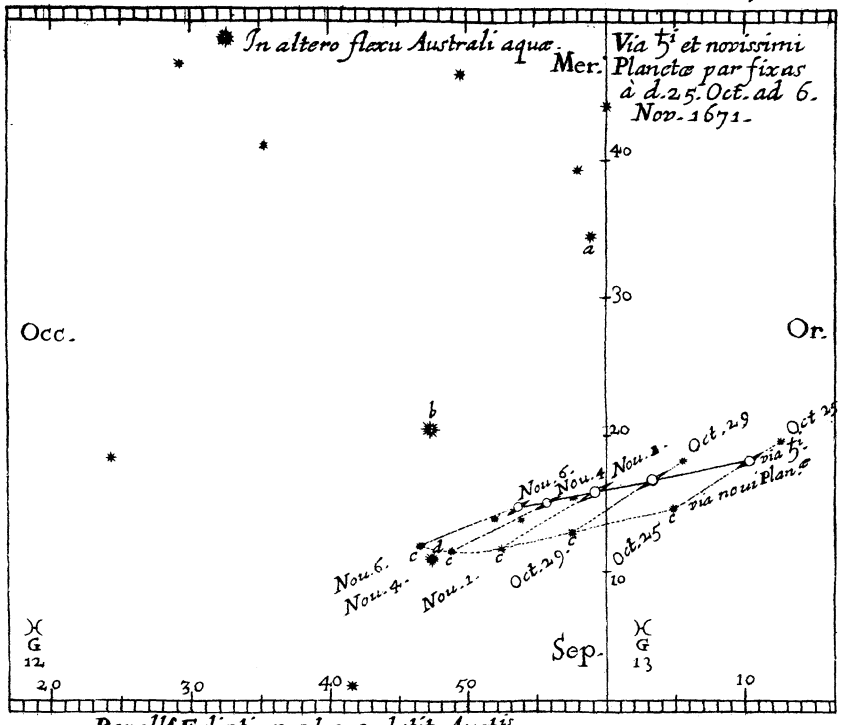
I

Planetæ noui circa ♄ ex Reg.o Obseruat.o detecti.
cum vetere intermedio.



II

Trans. N.o 92.



Parall.æ Eclipticæ ad g. 2. latit Aust.is

Observat.es aliquot ♄i rotundi cum stellis in recta linea cum ipso et vetere Satellite.

1671 Dec. 16. 24.

Mer.

24 ⊙ 16 24 16

1672. Jan. 23.

1672. Jan. 25.

Occ. Or.

1672. Dec. 13. 17.

13 17 13 17

Digressiones Comitis extimi à ♄o ad occidentem à d. 6. ad 19. Feb. 1673.

19 17 16 15 14 13 12 11 10 8 7 6

Sept.

Observat.es novi Intimi Comitis ♄i.

1. novus Intimus. 2. vetus medius.

1672 Dec. 23. h. 7.

Mer.

Dec. 30.

1673. Jan. 10.

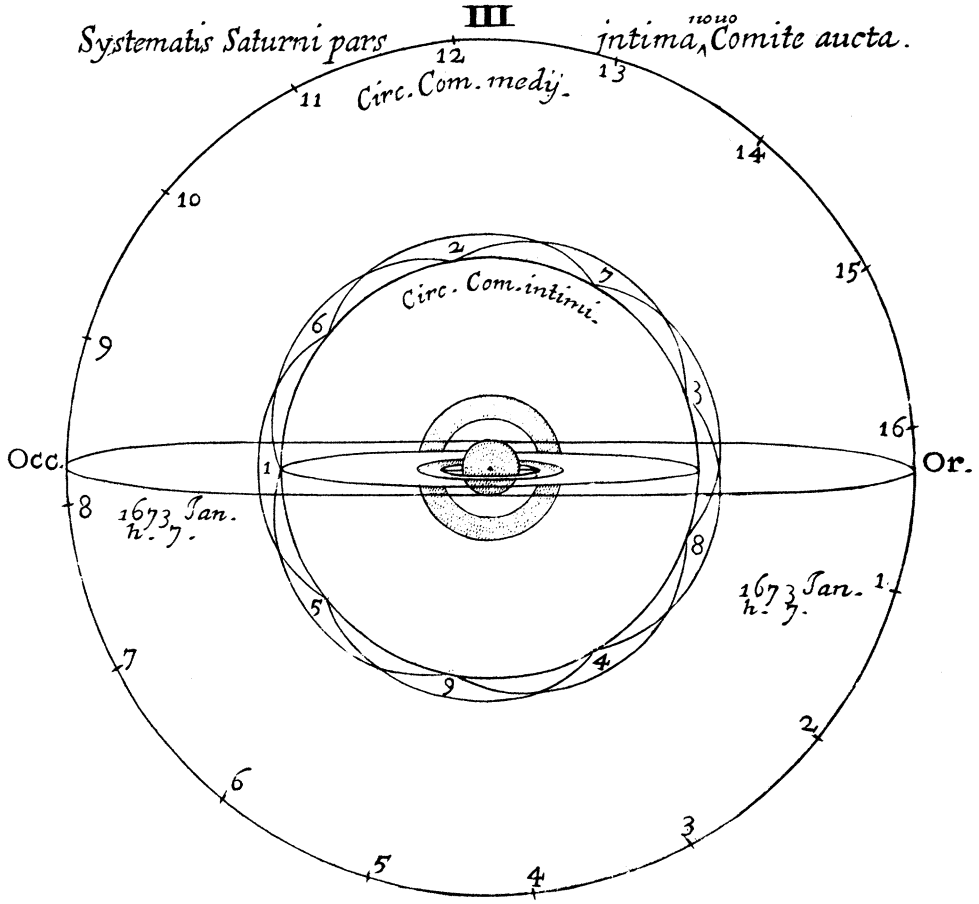
Occ. Or.

Jan. 15.

Jan. 17.

Jan. 19.

Sept.

III

Systematis Saturni pars intima, nouo Comite aucta.